

BAB 5

KESIMPULAN DAN SARAN

5. 1. Kesimpulan

1. Pemberian ekstrak etanol 96% Pandan laut (*Pandanus odoratissimus*) dapat menghambat pembentukan biofilm pada konsentrasi uji sebesar 5mg/100µL; 2,5mg/100µL; 1,25mg/100µL; 0,625mg/100µL; 0,3125mg/100µL 0,153mg/100µL; 0,078mg/100µL; 0,039 mg/100µL dan 0,019mg mg/100µL. Masing-masing konsentrasi memberikan hasil persentase penghambatan berturut-turut sebesar 81%, 67%, 58%, 35%, 93%, 83%, 40%, 30% dan 25%.
2. Golongan senyawa metabolit sekunder dalam ekstrak etanol 96% buah pandan laut (*Pandanus odoratissimus*) adalah flavonoida, fenolik dan terpenoid.

5. 2. Saran

1. Pada penelitian selanjutnya perlu dilakukan seluruh tahapan dari penelitian secara eksperimental di dalam laboratorium untuk memastikan kesesuaian antara pustaka dan jurnal acuan dengan hasil penelitian. Selain itu, rancangan estimasi waktu perlu diatur ulang agar dapat bisa melakukan seluruh tahapan penelitian secara eksperimental di dalam laboratorium.
2. Perlu dilakukan analisis menggunakan HPLC atau Spektro IR pada penelitian selanjutnya untuk benar-benar memastikan adanya kandungan kuersetin, luteolin dan 4-Hydroxy-3-(2',3'-dihydroxy-3'-methylbutyl)-benzoic acid methyl ester pada ekstrak etanol 96% buah pandan laut.

DAFTAR PUSTAKA

- Abranches, J., Zeng, L., Kajfasz, J. K., Palmer, S. R., Chakraborty, B., Wen, Z. T., Richards, V. P., Brady, L. J., Lemos, J. A. 2018, Biology of Oral *Streptococci*, *Microbial Spectr*, **6**(5): 1-14.
- Adkar, P.P., Bhaskar, V.H. 2014, *Pandanus odoratissimus* (Kewda): A Review on Ethnopharmacology, Phytochemistry, and Nutritional Aspects, *Advances in Pharmacological Sciences*, **19**: 1-20.
- Adriani, Y., Ramli, N.M., Syamsumir, D. F., Kassim, M. N. I., Jaafar, J., Aziz, N. A., Marlina, L., Musa, N. S., Mohamad, H. 2015, Phytochemical analysis, antioxidant, antibacterial and cytotoxicity properties of keys and cores part of *Pandanus tectorius* fruits, *Arabian Journal of Chemistry*, **2**(8): 1-24
- Ariffin, S. A., Mohsin, H. F., Eshak, Z., Wahab, I. A. 2012, Crystalline Calcium Oxalate in *Pandanus Odorattisimus*, *International Journal on Advanced Science Engineering Information Technology*, **2**(4): 24-26.
- Arifin, H., Anggraini, N., Handayani, D., Rasyid, R. 2006, Standararisasi Ekstrak Etanol Daun *Eugenia Cumini* Merr, *Jurnal Sains Teknologi Farmasi*, **11**(2): 1- 10.
- Astarina, N. W. G., Astuti, K. W., Warditiani, N. K. 2008, Skrining Fitokimia Ekstrak Metanol Rimpang Bangle (*Zingiber purpurea* Roxb.), Universitas Udayana, Bali.
- Backer, C. A., 1968, *Flora of Java* Vol. 3, Springer, Netherland, 132.
- Bailey, L. H., 1950, *The Standard Cyclopedia of Horticulture* Jilid I, The Macmillan company, New York.
- Barrow, G. I., Feltham, R. K. A. 1993, *Cowan and Steel's Manual for the Identification of Medical Bacteria*, 3^{ed}, Cambridge University Press, Cambridge.
- Bedran, T. B. L., Alzemat, J., Spollodoro, D., Grenler, D. 2013, Fibrinogen-Induced Streptococcus mutans Biofilm Formation and Adherence to Endothelial Cells, *BioMed Research International*, **4**: 1-9.
- Brooks, G.F., Carroll, K.C., Butel, J.S., Morese.S.A., Mietzner, T.A. 2013, *Jawetz, melnick and Adelberg's Medical Microbiology*, 26^{ed}., Lange medical book, New York.

- Chilakwad, S. R., Majunath, K, P., Akki, K. S., Savadi, R. U., Deshpande, N. 2008, Pharmacognostic And Phytochemical Investigation of Leaves of *Pandanus Odoratissimus* Linn. F., *Ancient Science of Life*, **28(2)**: 3-6.
- Cota, A. L. S., Alvim, R. G. 2018, Effect of Storage Temperature on *Streptococcus mutans* Viability, *Odontol UNESP*, **47(2)**: 74-78.
- Coykendall, A. L. 1974, Four Type of *Streptococcus mutans* Based On Their Genetic, Antigenic and Biochemical Characteristics, *Journal of General Microbiology*, **83**: 327-338.
- Daboor, A.M., Masood, S. S. F., Al-Azab, M. S., Nori, E. E. 2015, A Review on *Streptococcus mutans* With Its Diseases Dental Caries, Dental Plaque and Endocarditis, *Indian J Microbiol Res*, **2(2)**: 76-82.
- David, A. V. A., Arulmoli, R., Parasuraman, S, 2013, Overview of Biological Importance of Quercetin: a Bioactive Flavonoid, *Pharmacogn*, **10(20)**: 84-89.
- Departemen Kesehatan Republik Indonesia, 1985. *Cara Pembuatan Simplisia*. Indonesia, Jakarta.
- Dhotre, S. V., Davane, M. S., Nagoba, B. S. 2017, Periodontitis, Bactereremia and Infective Endocarditis : Review Study, *Pediatr Infect Dis*, **5(3)**: 1-8.
- Doughlas, C, W, I., Heath, J., Hmapton, K. K., Preston, F, E. 1993, Identity of Viridans *Streptococci* Isolated from Cases of Infective Endocarditis, *J. Med. Microbiol*, **39**: 179-182.
- Evans, W.C, 2009, *Trease and Evan's Pharmacognosy : Sixteen Edition*, Saunders Elsevier: Edinburgh.
- Fatmawati, D. W. A. 2011, Hubungan Biofilm *Streptococcus mutans* Terhadap Resiko Terjadinya Karies Gigi, *Stomatognatic*, **8(3)**: 127-130.
- Farnsworth, N. R. 1966, Biological and Phytochemical Screening of Plants, *Pharmaceutical science*, **55(3)**: 1-52.
- Foressten, D. S., Bjorklund, M., Ouwehand. A.C. 2010, *Streptococcus mutans*, Caries and Simulation Model, *Nutrients*, **2**: 290-298.
- Gurenlian, J. R. 2007^a, The Role of Dental Plaque Biofilm in Oral Health, *Journal of Dental Hygiene*, **81(5)**: 1-11.

- Gurenlian, J. R. 2014^b, Inflammation: the Relationship Between Oral Health and Systemic Disease, *Dental assistant*, Chicago.
- Gurmeet, S., Amrita, P. 2015, Unique Pandanus-Flavour, Food and Medicine, *Journal of Pharmacognosy and Phytochemistry*, **5(3)**: 8-14.
- Harborne, J. B. 1987. Metode Fitokimia. Terjemahan: Padmawinata, K dan Soediro, I. Institut Teknologi Bandung.
- Huang, R., Li, M., Gregory, R.L. 2011, Bacterial Interactions in Dental Biofilm, *virulence*, **2(5)**: 435-444.
- Junior, S. D. D. C., Santos, J. V. D. O., Campos, L. A. D. A., Pereira, M. J., Magalhaes, N. S. S., Cavalcanti, I. M. F, 2018, Antibacterial and Antibiofilm Activities of Quercetin Against Clinical Isolates of *Staphylococcus aureus* and *Staphylococcus saprophyticus* With Resistance Profile, *International Journal of Environment, Agricultural and Biotechnology*, **3(5)**: 1-11.
- Kawiji., Atmaka, W., Nugraha, A. A. 2010, Kajian Kadar Kurkuminoid, Total Fenol dan Aktivitas Antioksidan *Oleoeresin* Temulawak (*Curcuma xanthorrhiza* Roxb) dengan Variasi Teknik Pengeringan dan Warna Penutup, *Jurnal Teknologi Hasil Pertanian*, **3(2)**: 1-9.
- Kabera, J. N., Semana, E., Mussa, A.R., He, X. 2014, Plant Secondary Metabolites: Biosynthesis, Classification, Function and Pharmacological Properties, *Journal of Pharmacy and Pharmacology*, **2(7)**: 377-392.
- Kementerian Kesehatan RI, 2008, *Farmakope Herbal Indonesia*, Departemen Kesehatan RI, Jakarta.
- Kementerian Kesehatan RI, 2014, *Situasi Kesehatan Gigi dan Mulut*, Jakarta: Pusat data dan informasi Kementerian kesehatan RI.
- Kementerian Kesehatan RI. 1989, *Materia Medika Indonesia*, jilid 5, Departemen Kesehatan RI : Jakarta.
- Kementerian Kesehatan RI. 2000, *Parameter Standar Umum Ekstrak Tanaman Obat*, ed 1, Direktorat Jendral Pengawasan Obat dan Makanan, Jakarta.
- Khare, C. P. 2007, *Indian Medicinal Plants*, Springer, Berlin.
- Kidd, E., Fejerkov, O. 2016, *Essential of Dental Caries*, ed.4, Oxford University Press, Oxford.

- Kooltheat, N., Kamutchachad, L., Anthapanya, M., Samakchan, N., Sranujit, P. R., Potup, P., Ferante, A., Usuwanthin, K. 2015, Kaffir Lime Leaves Extract Inhibits Biofilm Formation by *Streptococcus mutans*. *Nutrition*, **32(4)**: 1-5.
- Kumar, D., Kumar, S., Kumar, S., Singh, J., Sharma, C., Aneja, K.R. 2010, Antimicrobial And Preliminary Phytochemical Screening Of Crude Leaf Extract Of *Pandanus Odoratissimus* L, *Pharmacologyonline*, **2**: 1-12.
- Kumar, S. 2012, 'Pharmalogical, Phytochemical And Pharmalogical Screening For *Bambusa Vulgaris* (Graminae) And *Pandanus Odoratissimus* (Pandanaceae)', *Tesis*, Doctor Of Philosopy, Medical University, Chennai.
- Puspasari, T. 2012, 'Penguajian Daya Antibakteri dari Destilat Burmani Cortex Terhadap *Staphylococcus aureus* dan *Streptococcus mutans*', *Skripsi*, Sarjana Farmasi, Universitas Katolik Widya Mandala, Surabaya.
- Larsen, T., Fiehn, N. E. 2017, Dental Biofilm Infections - an Update, *APMIS*, **125**: 376-384.
- Lebaux, D., Chauhan, A., Rendueles, O., Beloin, C. 2013, From In Viro to In Vivo Models of Bacterial Biofilm-Related Infections, *Pathogens*, **2**: 288-356.
- Lee, H. J., Park, H. J., Cho, H. S., Joo, S. W., Cho, M. H., Lee, J. 2013, Antibiofilm Activities of Quercetin and Tannic Acid Against *Staphylococcus aureus*, *Biofouling*, **29(5)**: 491-499.
- Lemos, J.A., Palmer. S.R., Zeng. L., Wen, Z.T., Kajfasz, J.K., Freires, I.A., Abranches, J., Brady, L.J. 2019, The Biology of *Streptococcus mutans*, *Microbiol Spectr*, **7(1)**: 1-26.
- Lin, D., Xiao, M., Zhao, J., Li, Z., Xing, B., Li, X., Kong, M., Li, L., Zhang, Q., Liu, Y., Qin, W., Wu, H., Chen, S. 2016, An Overview of Plant Phenolic Compounds and Their Importance in Human Nutrition and Management of Type 2 Diabetes, *Molecules*, **21**: 1-19.
- Marsh, P.D., Martin, M. V. 2009, *Oral Microbiology*, Churchill Livingstone, London.

- Marston, A., Hostetmann, K. 2006, 'Separation and Quantification of Flavonoids', in Andersen, O. M., Markham, K. R, *Flavonoids Chemistry Biochemistry and Applications*, CRC Press, New York, pp 1-36.
- Martinez, B., Ruiz, F. 2005, Periodontal Disease as Bacterial Infection, *AVANCES*, **17(3)**: 111- 118.
- Miean, K. H., Mohamed, S. 2001, Flavonoid (Myricetin, Quercetin, Kaemferol, Luteolin And Apigenin) Content of Edible Fruit, *Journal of Agric Food Chem*, **49**: 3106-3112.
- Nakano, M, M, 2018, Role of *Streptococcus mutans* Surface Protein for Biofilm Formation, *Japanese Dental Science*, **54**: 22-29.
- Ouyang, J, Sun, F., Feng, W., Sun, Y., Qiu, X., Xiong, L., Chen, Y. 2016, Quercetin is an affective inhibitor of quorum sensing, Biofilm Formation and Virulence in *Pseudomonas aeruginosa*, *Journal of Applied Microbiology*, **120**: 966-974.
- Paramita, N. L. P. V., Andani, N. M. D., Putri, I. A. P. Y., Indrayani, N. K. S., Susanti, N. M. P, 2019. Karakteristik Simplisia Teh Hitam dari Tanaman *Camelia sinesis* Var. Assamica dari Perkebunan Teh Bali Cahaya Amerta Desa Angseri Kecamatan Baturiti Kabupaten Tabanan Bali, *Jurnal Kimia*, **13(1)** : 58-66.
- Pratiwi, N. L. The Trend Analysis of Avaibility of Dental Caries and Dental Health Personel in Indonesia, *Dentistry*, **6(2)**: 1-10.
- Rabin, N., Zheng, Y., Temeng, C. O., Du, Y., Bonsu, E., Sintim, H. O. 2015, Agent That Inhibit Bacterial Biofilm, *Future Medicinal Chemistry*, **7(5)**: 647-671.
- Rahayu, M., Sunarti, S., Keim, A. P. 2008, Kajian Etnobotani Pandan Samak (*Pandanus odoratissimus* L. F.): Pemanfaatan Dan Peranannya Dalam Usaha Menunjang Penghasilan Keluarga Di Ujung Kulon, Banten, *Biodiversitas*, **9(4)**: 310-314.
- Rahayu, S. E., Handayani, S., Noverita, Jalip. I. S. 2013, 'Antifungal and Preeliminary phytochemical Screening of Leaf Extract of *Pandanus odoratissimus* L.f.', Fakultas Sains dan Teknhologi, *Proceeding International Conference*, Universitas Islam Maulana Malik Ibrahim, Malang, pp. 1-7.

- Raj, G. G., Varghese, H. S., Kotagiri, S., Swamy B. M. V., Swamy, A., Pathan, R. K. 2014, Anticancer Studies of Aqueous Extract of Root and Leaves of *Pandanus odoratissimus* f. *Ferreus* (Y. Kimura) Hatus: an in Vitro Approach, *Journal of Traditional and Complementary Medicine*, **4(4)**: 279-284.
- Ratnani, D. R., Hartati, I., Anas, Y., Endah, D., Khilyanti, D. D. D. 2015, 'Standarisasi Spesifik dan Non Spesifik Ekstraksi Hidrotropi Andrographolid dari Sambiloto (*Andrographis paniculata*)', Fakultas Farmasi, *Prosiding Seminar Nasional Peluang Herbal Sebagai Alternatif medicine*, Universitas Wahid Hasyim, Semarang, pp. 47-155.
- Riorane, C. J., Lee, J. H., Kim, Y. G., Rajeseckharan, S. K., Contetras, R. G., Lee, J. 2019, Antibiofilm and Antivirulence Efficacies of Flavonoids and Curcumin Against *Acinetobacter baumannii*, *Microbiology*, **10(990)**: 1-12.
- Robinson, T. 1991, *Kandungan Organik Tumbuhan Obat Tinggi*, Diterjemahkan oleh Kokasih Padmawinata, ITB Bandung.
- Rode, S. D. M., Gimenez, X., Gimenez, V.C., Gomez, M., Blanc, S. L. D., Medina, M., Pedrozar, J., Chiapa, R. M. Z., Pannuti, C. M., Cortelli, J. R., Oppermann, R. V. 2012, Daily Biofilm Control and Oral Health : Consensus on the Epidemiological Challenge-Latin American Advisory Panel, *Periodontics*, **26**: 133-143.
- Rus, H., Cudrici, C., Niculescu, F. 2005, The Role of the Complement System in Innate Immunity, *Immunologic Research*, **33(2)**: 104-112.
- Sahri., Jayuska, A., Rahmalia. W. 2019, Efek Pelarut Terhadap Spektra Absorpsi UV-VIS Kurkuminoid, *Jurnal Kimia Katulistiwa*, **8(1)**: 1-9.
- Sahu, B. P., Gounda, P., Patnaik, C. 2016, *Pandanus odoratissimus* Lin: Isolation of Stigmast-5, 22-Dien-3 β -Ol From Ethanolic Extract of Stem Bark and Study of Antimicrobial Activity, *Journal of Chemistry and Chemical Science*, **6(6)**: 574-585.
- Saxena, M., Saxena, J., Nema, R., Singh, D., Gupta, A. 2013, Phytochemistry of Medicinal Plants, *Journal of Pharmacognosy and Phytochemistry*, **1(6)** : 168-179.

- Schonfeld, S.E., Greening, A. B., Glick, D. H., Frank, A. I., Simon, J. H., Herles, S. M. 1982, Endotoxic activity in Periapical Lesions, *Dental PubMed*, **53(1)**: 82-87.
- Selwitz, R.H., Ismail, I. A., Pitts, N. B. 2007, Dental caries, *Lancet*, **369**: 51-59.
- Sherbiny, G. M. 2014, Control of Growth *Streptococcus Mutans* Isolated From Saliva and Dental Caries, *International Journal of Current Microbiology and Applied Sciences*, **3(10)**: 1-10.
- Slobodnikova, L., Fialova, S., Rendekova, K., Kovac, J., Mucaji, P. 2016, Antibiofilm Activity of Plant Polyphenol, *Molecules*, **2**: 2-15.
- Sobhana, K., Rao, V. G., Ravikumar, A., Sravanthi, R. R., Chandrkala, 2014. Evaluation of Cardioprotective Activity of *Pandanus odoratissimus* Leaves Against Isopreterenol Induced Myocardial Infarction in Albino Rats, *International Journal of Novel Trends in Pharmaceutical Science*, **4(5)**: 1-8.
- Son, N. T. 2019, Secondary metabolites of Genus *Pandanus*: an Aspect of Phytochemistry, *Organic Chemistry*, **16**: 689-710.
- Sumardi., Basyuni, M., Wati, R. 2018, Antimicrobial Activity of Polyisoprenoids of Sixteen Mangrove Species From North Sumatra Indonesia, *Biodiversitas*, **19(4)**: 1243-1248.
- Susiati, S., Rahayu, M. 2010, Kajian Etnobotani Pandan Samak (*Pandanus tectorius* Sol.) di Kabupaten Tasikmalaya Jawa Barat, *Berita Biologi*, **10(1)**: 113-121.
- Veloz, J. J., Alvear, M., Salazar, L. A. 2019, Antimicrobial and Antibiofilm Activity Against *Streptococcus mutans* of Individual and Mixture of the Main Polyphenolic Compounds Found in Chilean Propolis, *BioMed Research International*, **2**: 1-8
- Vos, P.D., Garrity, G. M., Jones, D., Krieg, N. R., Ludwig, W., Ralney, F. A., Schelfer, K. H., Whitman, W. B.(eds). 2009, *Bergey's Manual of Systematic Bacteriology*, 2^{ed}, Springer, London.
- William, L., Wilkins. 2005, *Antibiotics in Laboratory Medicine*, 5^{ed}, Baltimore, Philadelphia.
- Woznicka, B., Kuznair, A., Nowak, D., Nykiel, E., Kopacz M., Gruszecka, J., Golec, K. 2013, Comparative Study on the Antibacterial Activity of Some Flavonoids and Their Sulfonic Derivates, *Pharmaceutica*, **70(3)**: 567-571.

- Xie, Y., Yang, W., Tang, F., Chen. X., Ren. L. 2014, Antibacterial Activities of Flavonoids: Structure-Activity Relationship and Mechanism, *Current Medicinal Chemistry*, **22**:132-149
- Xin, X., Yuan, Z., Wenyuan, S., Yaling., Xuedong, Z. 2016, 'Biofilm and Dental Caries' in Xuedong, Z., Dental Caries Principle and Management, Springer, Chengdu, pp 33-36.
- Zeng, Y., Nikkinova, A., Abdelsalam, H., Li, J., Xiao, J. 2018, Activity of Quercetin and Kaemferol Against *Streptococcus mutans* Biofilm, *Elsevier*, **98**: 1-24
- Zeng, Y., Youssef, M., Wang, L., Alkhars, N., Thomas, M., Cacciato, R., Qing, S., Mapes, O., Xiao, J. 2020, Identification of Non-*Streptococcus mutans* Bacteria From Predente Infant Saliva Growth on Mitis-Salivarius-Bacitracin Agar, *Journal of Clinical Pediatric Density*, **44(1)**: 28-34.
- Zhu, B., Macleodi, L. C., Kitten, T., Xu, P. 2018, *Streptococcus sanguinis* Biofilm Formation and Interaction with Oral Pathogen, *Future microbiology*, **10**: 1-18.